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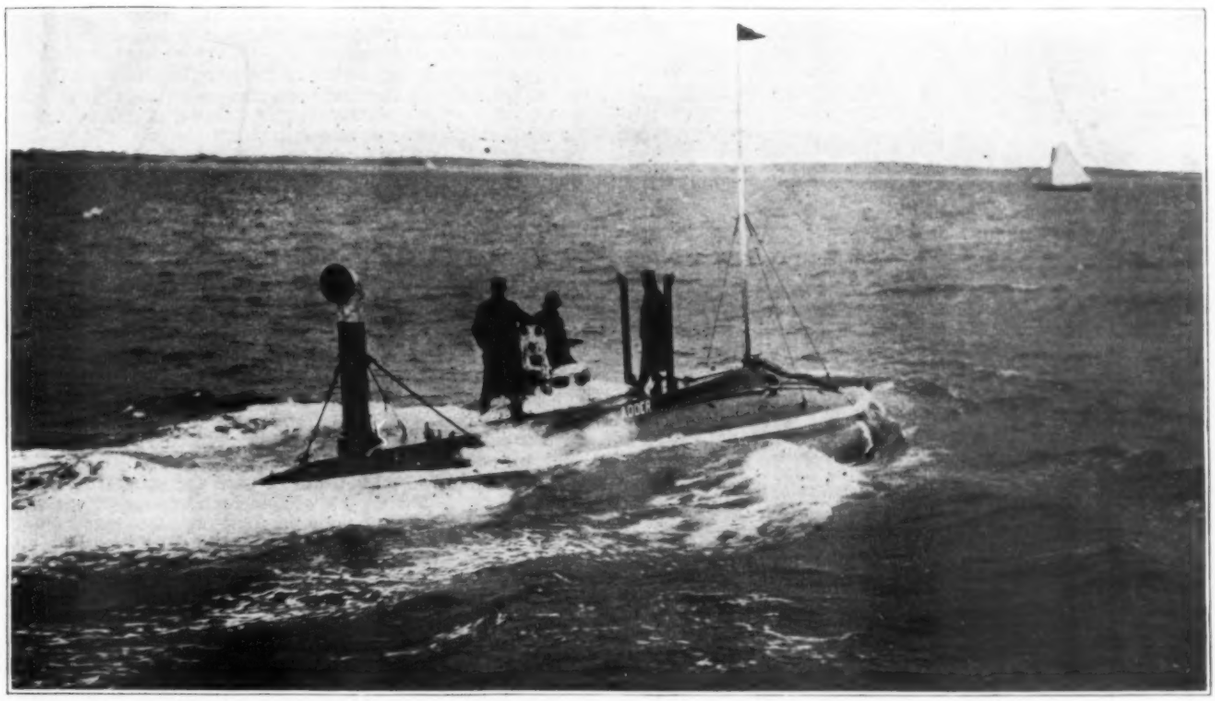
America's Newest and Deadliest Submarine



Its Operation and Construction Described by an Army Officer Who Journeyed With It Under the Sea--See Page 18

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Test of America's Newest Submarines

Construction and Operation Described by Lieutenant White Who Accompanied the Boats in their Ride Under the Sea

By William Russell White, Lieutenant U. S. Navy, Contributor to the Journal of the American Society of Naval Engineers

Submarine navigation, though successfully attempted in shallow water by Robert Fulton nearly a century ago, is yet to be actually accomplished for any continuous period in deep water, though the possibility and practicability of such work is strongly maintained.

The United States navy has had one submarine boat (Holland) in commission for over three years. Congress has authorized the construction of six additional submarine boats of the improved Holland type. Two of these boats, the Adder and Moccasin, were officially tested in the sheltered and shallow waters of Peconic Bay, Long Island. These tests continued for a period of seven days and it is to be regretted that the official trials did not take place in deeper water, so that the endurance, the habitability and stability of the boats while in unprotected waters could have been more definitely ascertained.

The writer of this article was particularly detailed to observe and report on the performance of the boat at the special request of the engineer-in-chief of the navy, and he was present in both boats during every trial. Three artillery officers from the School of Submarine Defense witnessed, from the tenders of the submarine boats, the three-hour submerged run of the Adder; also the mile submerged run of the Moccasin when that boat fired her torpedo. The limited capacity of the submarines and the character of their construction made it impossible for other than two or three of the naval officers, the crew of the boats, consisting of six men, and a representative of the Holland Company to enter the craft during the submerged tests.

The Adder and Moccasin are sister boats, being improved Hollands. Their hulls are cigar shaped, like that of a Whitehead torpedo, every cross section being a circle; the greatest diameter is 11 feet 10 inches, and the length 63 feet 4 inches.

For propulsion on the surface power is transmitted to the propeller shaft, through means of gearing, by two methods –

(1) By a four-cylinder gasoline engine of 160 horsepower, each cylinder of which can be used independently of the others.

(2) By a 70-horsepower electric motor which receives current from storage batteries having a capacity of 1,900 ampere-hours at a normal rate of discharge.

When leaving or coming alongside a dock or vessel the electric motor alone is used, because there is no way to reverse the screw when using the gasoline engine.

Only the electric motor can be used for submarine propulsion, because it is then impossible to secure sufficient air to operate the gasoline engine, and it is also impossible to get rid of the dangerous gases of combustion that leak from joints and from valves into the boat.

Submergence is obtained by the use of diving rudders and the filling of the trimming and ballast tanks. Emergence is obtained by the expulsion of the water ballast and by operating the diving rudders. The diving and vertical rudders are worked by hand, the power being transmitted very satisfactorily through gearing.

A single, left-handed, three-bladed screw is used to propel these submarines. Its efficiency is very low, due to its small size, to its high pitch and to the speed of the engine.

The Adder ran in a submerged condition, with the electric motors in use, for a period of three hours. During the first two hours and 20 minutes of this trial her motor made sufficient revolutions to give the boat an average speed of seven knots. The time lost in firing the torpedo was made good. During the last half of the third hour the speed of the boat decreased, due to the fact that the storage battery ran down, the voltage having fallen rapidly. The average speed for the three hours during the submerged run was 6.88 knots, seven knots being required by the contract.

While the Adder was submerged and under way two torpedoes were fired at the target, the helmsman as nearly as possible under the conditions heading the boat toward the target. Similarly one torpedo was fired from the Moccasin. Neither boat made a hit.

From what the writer observed as to the performance of the Adder and the Moccasin—and he was on board both boats during every submerged and every surface run that they made on these official tests—he is convinced that the limitations of the submarines for continuous submerged work is proportionate to the capacity of the storage battery, to the skill and to the physical endurance of the crew.

People of the United States have been called on to contribute to a $3,000,000 national art museum to be erected in Chicago.

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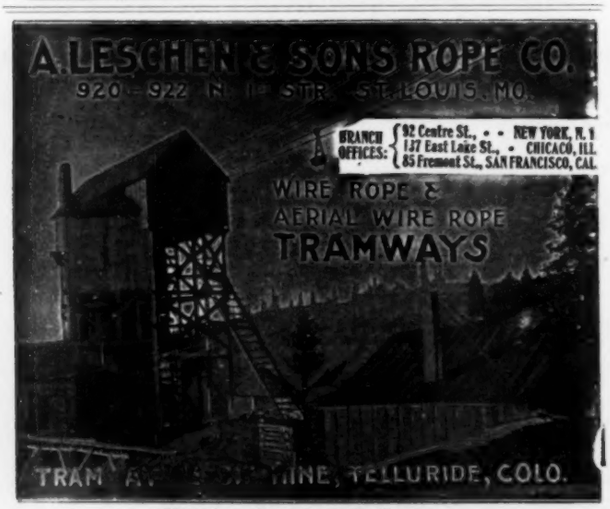
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Radium, the Greatest Find in History

Noted Scientist Tells Popular Mechanics of Its Wonderful and Mysterious Powers

By William J. Hammer of New York, Winner of the Gold Medal of Franklin Institute.

Radium, polonium, actinum and thorium—these are the remarkable substances recently discovered which give off light the moment they are created without having to be stimulated by any form of heat, light, electrical or other vibrations, so far as we are at present aware. They are likely to teach us more about the constitution of matter and the co-relation of the vital and physical forces than any substances which have been created since the world began. Of the three substances, radium is by far the most important. It is doubtful whether any substance has been discovered in the history of the world of such stupendous interest and importance and possessing such puzzling characteristics as radium which seems so at variance with well established scientific theories as to the constitution of matter.

Up to the present time the laboratory in France in which the radium is prepared, and which is under the control of Prof. Currie, has not permitted any radium to be sent out with a radioactivity over 7,000, the better grades being retained for investigations going on at the laboratory.

I have within a few days, however, received a letter from the laboratory stating that shortly radium would be placed upon the market at a cost of $6,000 per gram ($2,721,555.90 per pound.)

None of the theories which up to the present have been advanced satisfactorily accounts for all the phenomena due to radium.

Preparations of radium have been made in a dark room and have been kept there for a period of two years, and during that time have not lost their luminosity in the slightest degree. One might almost consider that this substance is matter tearing itself into pieces and projecting these pieces with from half to the full speed of light, for the particles are evidently carried through all matter. The walls of the room and the clothes of those who are present are at the moment all radioactive, due to the presence of radium in the room. This and other phenomena of radium cause one to naturally hark back to the Newtonian corpuscular theory of light.

Prof. Currie told me that he was frequently forced to delay his tests for a period of three or four hours by reason of the fact that he had been exposed to some radium and his clothes had become so radioactive as to prevent his going near his instruments.

By wrapping a little cotton around one of these tubes and holding it in the dark you will find that the entire mass is brilliantly phosphorescent. This is not due to the mere light passing through the cotton, but to the fact that the cotton itself has become radioactive.

Elster and Geitel have shown that if a wire is placed in the atmosphere and charged negatively from a source of current, say 500 volts, the wire itself becomes radioactive, and this radioactivity can be scraped off, and will affect photograph plates, ionize the air, etc.

It has been demonstrated that the rays emitted from radium are composite, and these have been classified as of three kinds—first, the Alpha rays, which are only feebly penetrating, and which, therefore, are easily absorbed by thin layers of matter; second, the Beta rays, which are negatively charged electric particles, or electrons moving with a high velocity, and which are in all respects like ordinary Crookes rays; and, third, the Gamma rays, which are not deflected by magnetic action and yet which are of a highly penetrative character, like the Roentgen or X rays. This is the classification made by Prof. Rutherford of Montreal. Prof. George F. Barker of Philadelphia says that the rays from polonium appear to consist entirely of Alpha rays, those from uranium to consist entirely of Beta rays, and those from radium and thorium to consist of all three.

The X rays are the rays with greatest penetrative quality and may produce an effect in the air even a meter or more distant. These rays are not at all influenced by the magnet. None of the rays from radium can be reflected, refracted, or polarized, showing that they are not mere light waves. The rays from radium produce many interesting chemical effects.

Light on the Mysterious Farallones

Strange Islands Brought Nearer to Civilization by Cable and Wireless Telegraphy

The rocky, storm beaten mysterious Farallone islands, so long isolated from the world, are to be connected with the San Francisco and the mainland by means of wireless telegraphy and a cable. Already the cable has been laid, but it is not yet in working order, awaiting the establishment of a station. The wireless telegraph station is to be located at or near the light-house, which is just beyond the natural tunnel in the great rock shown in the picture.

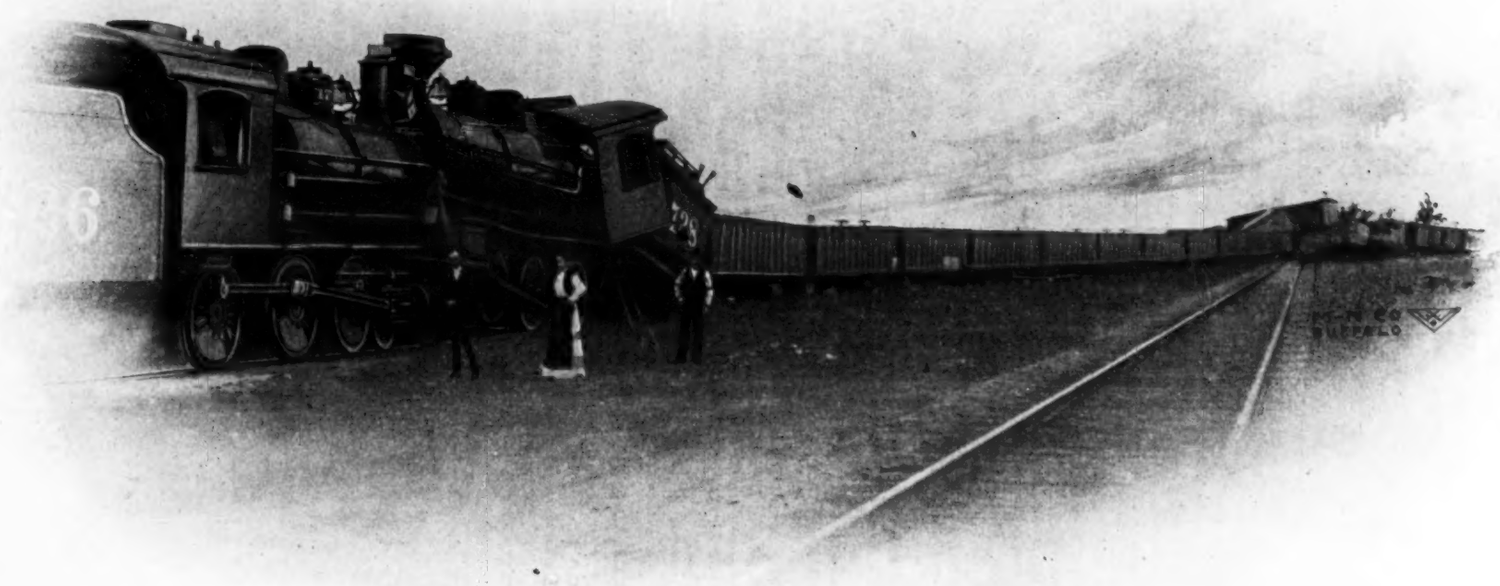
The Farallone Islands, although but twenty-seven miles from San Francisco, have heretofore been regarded almost as a distant continent. Many stories are told of strange unearthly happenings there. Besides the light keeper, who may not see a human face for six months, the principal inhabitants of the islands are sea gulls. These swarm in countless thousands about the sharp and rugged rocks. The beach is literally strewn with their eggs during the breeding season and boat loads of them are often gathered and sent to San Francisco where they are eaten as food, though not relished by many because of their strong taste. The islands are exposed to the full fury of the western ocean and even the hardened rocks are scarred with the lashing of the waves during the terrific gales. The light-house is a first order one and is regarded as one of the most important on the Pacific coast.

Farallone Islands, in Pacific

PAPER FROM SAW MILL REFUSE.

An excellent sample of wrapping paper made from pine shavings and other saw mill refuse is contained in a recent issue of Dixie. The paper was made in Texas

Popular Mechanic want ads. are for public accommodation.



Future Trains Will Be of Steel

Wooden Freight and Passenger Cars Have Seen their Day, and are Doomed

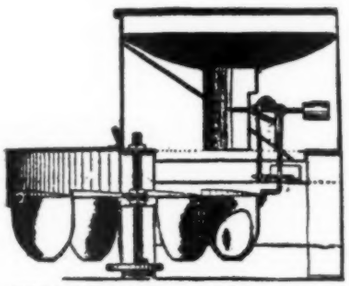
The wooden car for freight and passenger traffic is doomed. Great trains of metal cars are to haul our commerce across the continent and metal passenger coaches will carry us on our journeys. Already the steel freight train has come and so pronounced has been its success that it is hurriedly supplanting the old-style wooden cars on all the leading railroads of the country. As to the steel passenger coach, it will be only a short time until it makes its debut on the Illinois Central and the predictions are that it will become an even greater favorite than the steel freight cars. Passengers will be more secure in the cars of steel, for, as has been proven with the steel freight trains, it is almost impossible to demolish them. In wrecks where the trains were composed of both steel and wooden cars the latter have been torn to splinters, while the metal cars remained uninjured. A given weight of steel will carry much more than the same weight of wooden car, hence the lighter weight necessary to carry a given load makes the steel car much more economical. Other advantages are: Reduced number of cars required, reduced friction and atmospheric resistance; reduced empty car movement; reduced switching service; reduced train length; reduced payment for car mileage and cost of inspection; reduced number of parts; longer life; no insurance; greater salvage; increase in traffic, capacity of sidings, terminals, and, in fact, the entire road; decrease in cost of repairs from an average between $35 and $40 per annum for wooden cars to an average, established by complete records, of $10 to $15.

But nowhere has the superiority of the metal car over the wooden car so conspicuously manifested itself as in wrecks. In the recent wreck on the Union Pacific, shown in the illustration, none of the steel cars was injured, while the wooden cars at the rear of the train were piled up in a conglomerated heap. The wreck was the result of a head-end collision.

PATENT HEN'S NEST.

Eggs Drop Into Revolving Pockets Out of Harm's Way

A patent hen's nest with automatic movable pockets for receiving the eggs is the latest device to prevent the eggs from being eaten by the hens, devoured by rats or stolen by persons. The pockets are arranged underneath the nest and are revolved round by a rotary mechanism which presents each of the pockets in turn beneath the opening in the bottom of the nest to receive the egg. The pocket remains stationary until the egg is laid. In the egg's fall into the pocket it touches a spring which causes the circle of pockets to revolve presenting the next pocket to receive the egg and so on. The pockets and operating mechanism are concealed from view and there is nothing to indicate to the unsuspicious hen that the nest differs from the ordinary kind.



CUPS REVOLVE UNDER NEST.

REMARKABLE WATER WORKS IN AUSTRALIA.

Cost $15,000,000—Supplies Only 50,000 People

In proportion to the number of people served the most costly water works in the world has just been finished at the gold fields in the Kalgoorlie district, Australia. Away back in the mountains, 328 miles away, is gathered the clear, sweet waters, and conducted across deserts and salt lakes, over hills, and through deep valleys, it at last finds its way to the thirsty gold fields where the only water the earth yields is salt and poisonous. Heretofore the people have had to depend on what water could be caught during occasional showers, but there was always the impending danger of a water famine and it was ever used very sparingly. The pipe line now laid is 30 inches in diameter, and will afford an ample supply for the 50,000 people in the mines. A remarkable problem in the work was to raise the water 2,700 feet during its journey. This is accomplished by eight pumping stations which alone cost $1,500,000. In the mountains great reservoirs have been built seven miles long. The gold fields are said to be the richest in the world.

A well caved in on Henry Streitz, at La Crosse, Wis., recently. A bystander observing the pending accident, threw to Streitz a line of hose. Through this the man breathed until the tons of sand were removed and he escaped uninjured.

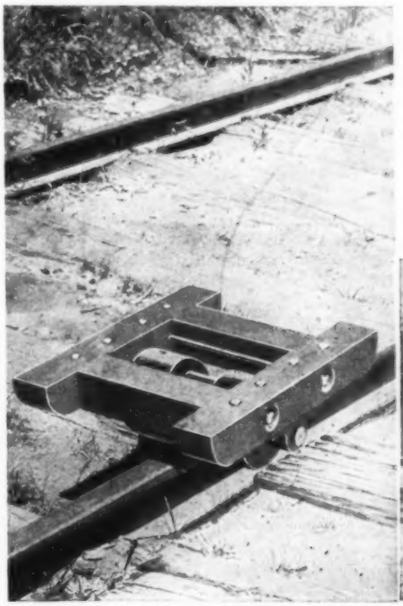
Smallest Freight Cars in the World

Run on Single Rail--Haul Heavy Loads and Are Operated by One Man

The smallest freight cars in the world for actual railway traffic are manufactured in Lowell, Mass., and are now being used on many railroads in the east. They are operated by one man power and are run on one rail. Some have but one wheel; some have two arranged tandem style. When a train approaches the little cars can be quickly switched off the track and run on the ground until the train has passed. Some of them are made in wheelbarrow fashion and are called track barrows. The little devices have proven great labor savers in railway construction and similar usage. The two-wheel cars are called "pony" cars. They weigh just 100 pounds each. They are used for carrying tools, ties, poles, signal rods, lumber, stones, etc. They are exceedingly convenient where materials of this kind have to be moved short distances while work is in progress. The frame is iron faced. A heavy load on one of the cars can be easily pushed by one man.

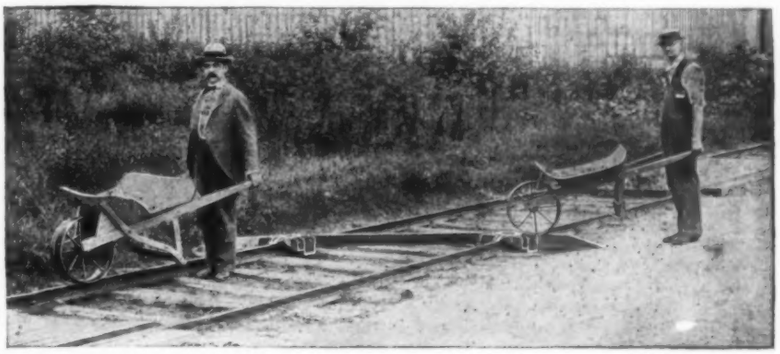
Pony Car

The one-wheel car is called a timber track truck. It is a dolly for handling heavy bridge timber or similar material. The roller is grooved to run on one rail but is equally serviceable on plank, or when turned bottom up for running timber over the roller. The trackbarrow is a wheelbarrow with a double-flanged wheel for running on the rail, the wheel being skewed enough to enable the person handling the barrow to walk aside the rail instead of astride.



Timber Track Truck

Loaded Pony Car



The Track Barrow

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ENERGY IN EVERY ELEMENT.

Possibility of Finding a One and Ultimate in all Matter

Reducing all the elements of matter to a one and ultimate, is posible by finding that each and every element is resolvable into a single form of energy, declared Sir William Crookes in a recent talk before the International Chemical congress at Berlin. The subject was "Modern Views on Matters—the Realization of a Dream." Sir William cited the utterances of Sir Humphrey Davy and Faraday as anticipating the possibility of reducing the elements to simpler bases and sketched the significance of the Roentgen rays, and the experiments of the Curries, the discoveries of radium, and others. He said:

"All these observations find internal connection in the discovery of radium, which is probably the basis of the coarser chemical elements here. Probably masses of molecules dissolve themselves into the ether waves of the universe or into electrical energy. Thus we stand on the border line where matter and forces pass into each other. In this border land lie the greatest scientific problems of the future. Here lie the final realities, wide reaching and marvelous.

"The nineteenh century saw the birth of new views regarding the nature of atoms, electricity, and ether. While our views about the composition of matter are generally satisfactory today, will that be the case at the end of the twentieth century?

"Do we not again see that our investigations have only a temporary value? Will we be content to see matter dissolving into a multitude of revolving electrodes?

"Such a mysterious dissolution of atoms appears to be universal. It occurs when a particular piece is rubbed with silk. It is present in sunshine, in a rain drop, in lightning, in a flame, in a water fall, and in the roaring sea.

"Although the whole range of human experience is too short to form a parallax whereby we can foretell the disappearance of matter, nevertheless it is posible that formless nebulæ will prevail again when the hourglass of eternity has run out."

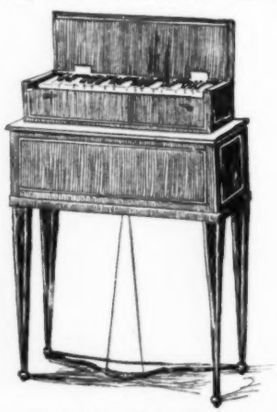
History of The Reed Organ--Part II.

How Harmonium Acquired the Name of Organ--The Old Time Melodeon

By Henry Lowell Mason, Contributor to the Presto.

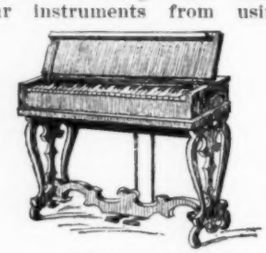
It was not until 1840 that an instrument of real importance embodying the free reed was produced and that was the Harmonium, invented by Alexander Debaine in Paris.

Debaine produced tones of superb timbre or quality by modifying the reed chambers, and he contrived to operate



Harmonium—of French Origin

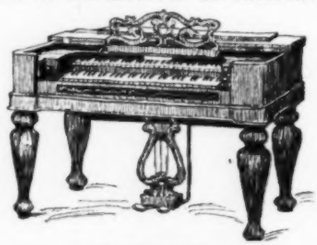
the various registers, or sets of reeds, from one key-board. He secured letters-patent for his invention, though unfortunately he patented too much, for he included in his claim the name Harmonium, thus debarring other makers of similar instruments from using this



Melodeon—Portable

name, and as a result they borrowed the name of the most dignified of all instruments, "Organ," thus applying this name to a class of instruments which were not in reality organs at all.

Debaine's invention has served more or less as the model of all successive in-



Organ Melodeon

struments of the kind. In his Harmonium the bellows were on the force system, so-called.

Reed instruments with key-boards were first constructed in the United States about the year 1818, and from almost the first they were and have been to the present time made with the exhaust bellows, though different makers have from time to time put upon the market Harmoniums with the force system (notable among these is the Vocalion), though the exhaust system still remains the popular one in this country.

The first instrument to command general attention was the Melodeon, a free reed wind instrument with key-board. Melodeons were at first made with the force system of bellows, similar to Harmoniums, but after a short time the exhaust system was adopted. Melodeons were at first made on the Harmonium system, but in 1846 one J. Carhart took out a patent for a single suction or exhaust bellows, and he was the first to apply this system to the Melodeon.

Among the pioneer and largest manufacturers of Melodeons up to 1850 was the George A. Prince Co. of Buffalo. This company introduced from time to time advances in construction, and among them was an instrument called the New Organ Melodeon. This instrument had two banks of keys, four sets of reeds, and one independent pedal set

Melodeon—Piano Style

of one and one-half octaves. However, it still had one bellows and fundamentally it was but a slight advance over the Melodeon.

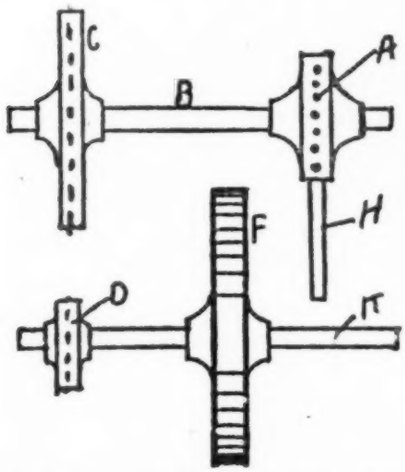
MIXING PUTTY.

In mixing putty so that it will sandpaper easily and smoothly, white lead should be used, together with coach japan and a very little varnish. It can be thinned by the use of turpentine, says the Carriage Monthly, to the consistency required. If too much varnish is used, the putty will be tough, and will glaze under the sandpaper. For general use the addition of one-third whiting to two-thirds dry white lead will cause the putty to dry harder than white lead alone will do. When a putty is wanted for filling up nail holes or to cover up screw heads, if the job is to be finished in the natural color of the wood, the lead can be stained with a little sienna or yellow, or raw umber and yellow, or burnt umber, to match the color of the wood. Little putty should be used on natural wood jobs, however, and if it is used at all it should be painted and grained like the iron work, so as to match the wood as closely as possible. Grained leather is suitable for covering dashes and fenders on jobs finished in natural wood.

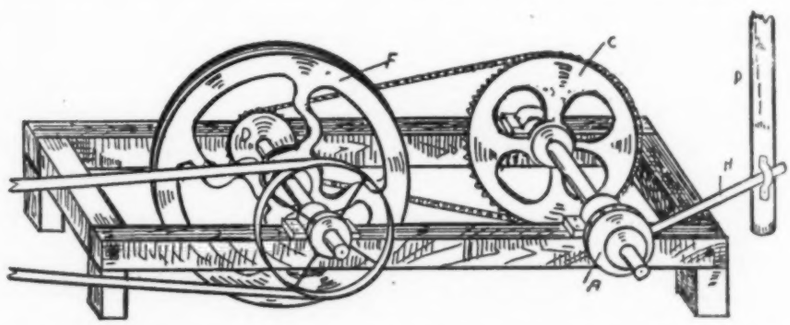
HOW TO MAKE A WINDMILL TURN A CHURN.

Hoard's Dairyman tells how to make a windmill do the churning. The machine is simple and can be made from cast-off parts to be found on nearly every farm.

Take an old mower drive wheel and break all of the rim off and all of the spokes but one, as A. Remove the other drive wheel and put A back on its shaft B with the clogs in drive wheel hub. Now make some bearings for the shaft B, on well platform, so point H comes as near in direct line with the pumping rod as possible. Connect point H with pumping rod, so that when the rod P goes up, it will raise H, turning the shaft B by means of the clogs in drive wheel hub, and as the pump rod descends H will descend with it and the cogs will take a new hold and you can get about one-quarter turn of



shaft B for each stroke of pump. Now put the sprocket wheel C on B, keying it fast; run a sprocket chain from C to pinion D on shaft K and heavy balance wheel F, keyed to shaft K-D, should make 8 to 12 revolutions to 1 of C. The thing should work like this: As the pump rod goes up it gives one-quarter of a revolution to C, if C is eight times as big as D. F will turn twice around, while the pump rod goes up, and F should make nearly two more revolutions by its own momentum, while the pump rod is coming down. So for each up and down stroke of the pump rod you get four revolutions of F. Now put a belt wheel on K and connect with

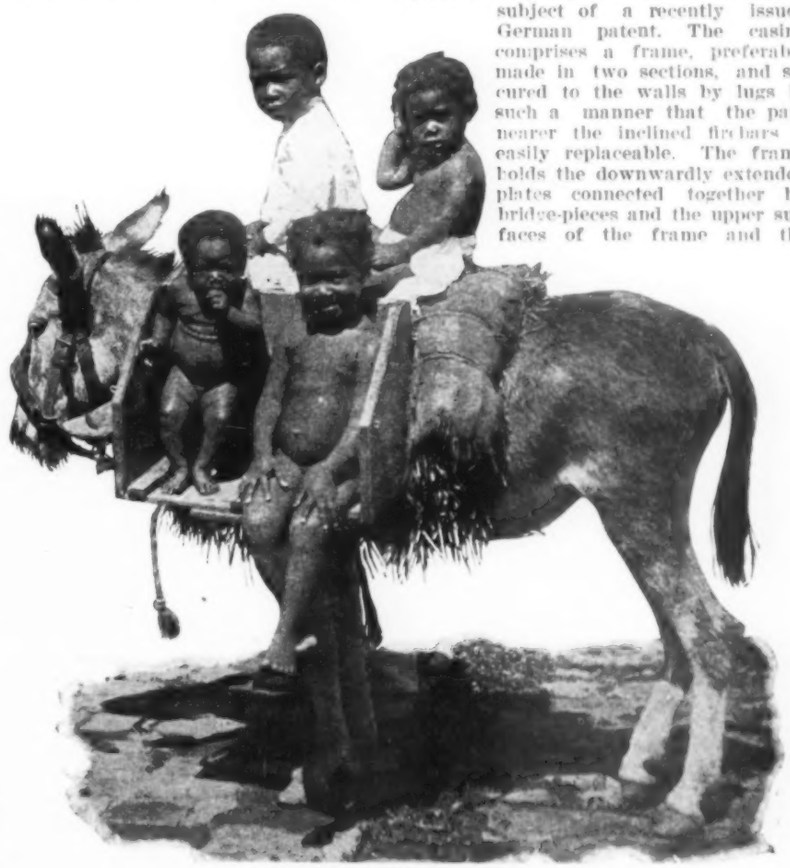


churn, and if you have got a fair breeze and a good steel windmill the churn will go all right. Cog wheels will work just as well as a sprocket chain.

TRANSPORTATION IN CUBA.

Donkey Trains Giving Way to Engines and Pas enger Coaches Under American Control

New railroads being built by Americans are working wonderful changes in the methods of transporation in Cuba. The passenger train is succeeding the pack train, which used to supply the needs of hauling families and their possessions from one part of the island to another. The father and mother would ride on a donkey ahead and lead the donkey bearing their children. The private family conveyance for transporting the children consisted of a donkey, equipped with balanced seats hung across his back. Such an equipment is shown in the accompanying illustration. The American Tourists' Association, which conducts thousands of Americans to the tropics every year is displaying great enterprise in collecting views of these passing Cuban scenes that an accurate record of them may be preserved for future reference.



Cuban Children on Journey

DRAFT INDUCER.

A casing which is interposed between the wall and the firebars of an inclined grate to increase the draft forms the subject of a recently issued German patent. The casing comprises a frame, preferably made in two sections, and secured to the walls by lugs in such a manner that the part nearer the inclined firebars is easily replaceable. The frame holds the downwardly extended plates connected together by bridge-pieces and the upper surfaces of the frame and the plates slope down from the walls to the firebars to keep the fuel in the middle as it slides down the grate.

FOUR DAYS TO CROSS OCEAN.

Turbine Steamship May Solve Problem of Swift Ocean Traffic

The business man's dream of four days across the Atlantic may be realized through the turbine steamship. A line equipped with such boats is now being pro'ected by Sir Christopher Furness, the noted English ship and marine engine builder. One vessel equipped with turbine engines has already been ordered. Its practicability for trans-Atlantic trade is to be tested thoroughly.

"Professor," said the bad young man of the class, "the scientists tell us the anthracite supply of the world will be completely exhausted in a little over 60 years. What are we to do for fuel then?" "My friend," replied the venerable man, "by that time in all probability you will have gone where the fuel supply is inexhaustible."

EASY ELECTRICAL EXPERIMENTS

By L. P. Dickinson

HOW TO MAKE A LARGE INDUCTION COIL.

While the induction coil to be described in the following chapters would not be classed as a large coil by many manufacturers, yet it is much more powerful than the amateur ordinarily meets with. It is capable of furnishing a spark four inches in length, representing an electromotive force of something like 160,000 volts. Such a coil will excite an X-ray tube quite well, and will operate satisfactorily in wireless telegraph work also.

It is assumed that the reader is already familiar with the essential parts of an induction coil. As is well known, such a coil consists of a primary, surrounding an iron core, and a secondary coil surrounding both the primary and the core,

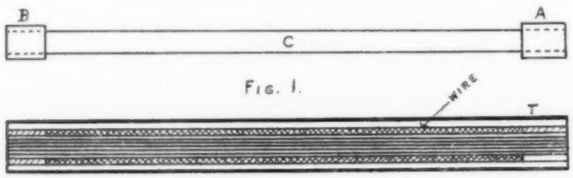


Fig. 1.

but securely insulated from both. In our coil, the principal difficulty will be to properly insulate the secondary coil, against the high voltage generated within itself.

To make the primary coil, we shall need first, a smooth, firm core composed of a bundle of soft iron wires, 12¾ inches long and ½ inch in diameter. The separate wires composing this bundle should be about No. 20 B. & S. gauge, and should be very soft and straight. Fit tightly to the ends of this bundle two wooden ends, made by turning from maple or other tough wood, two thimbles of the shape shown at A and B in Fig. 1. Each end-piece is 1 inch in length, ¾-inch in external diameter, and ½-inch in internal diameter. They should slip tightly upon the iron core. As this involves quite a stress upon the ends, it may be well to turn two or three grooves in the outer surface of each, in which strong binding strings may be wound, to prevent splitting.

Now cover the central portion of the core with a layer of paper, fastened on with shellac. Then wind in this space two layers of No. 16 double cotton covered magnet wire. This will make a primary coil whose external diameter is ¾-inch, and whose length is 12¾ inches.

Secure from a stationer, one of the ordinary tubes used for sending pictures through the mail. This tube should be 1¼ inches in external diameter, and of the same length as the core. We wish to secure the primary coil, with its core, in the center of the pasteboard tube, and there to fill the intervening space with an insulating mixture. Accordingly the tube should be closed at one end by a piece of heavy pasteboard glued in place, and then held in a vertical position, with the closed end downward.

Carefully insert the primary coil into the center of the tube, while vertical, and then pour into the tube, a mixture made up of melting 4 pounds of rosin with 1 pound of beeswax. This mixture should be poured in hot, and the tube left undisturbed until it is cold. However, when the mixture cools it contracts, and as fast as it contracts mor mixture must be poured in so as to keep the tube full. When these operations are complete, we shall have a primary coil completely encased in a layer of wax, except at the ends, the whole being encased in a pasteboard tube. The latter should be given a thorough coat of shellac, and set aside to dry. A section of the finished primary is shown in the lower part of Fig. 1. The ends of the coil should project from one end for a distance of about six inches.

In our next chapter we shall describe how to make the secondary of our coil.

ORIGIN OF THE WORD "STATEROOM."

Congressman Aldrich of Alabama Tells Entertainingly of How it Started.

By Congressman Aldrich of Alabama.

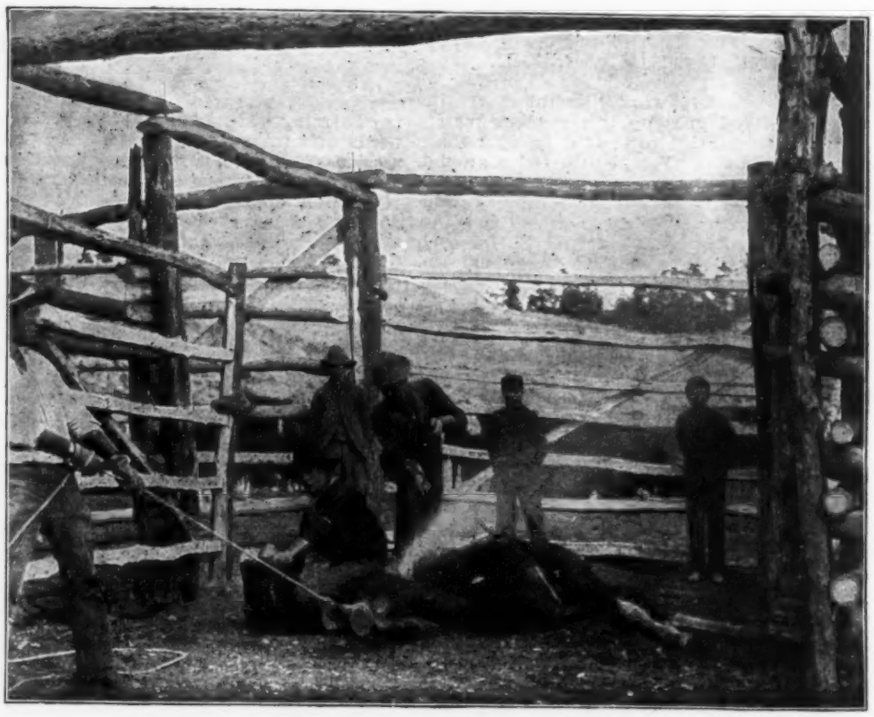
There is probably not one person in a thousand who knows how the name stateroom, now so common, originated. This is the way it happened. Down in Louisiana is the thriving city of Shreveport. The man after whom the city was named was old Capt. Shreve, who used to run some of the finest craft that ever carried the traveling public up and down the Mississippi river.

Capt. Shreve was a progressive sort of fellow and he believed in giving the passengers the best possible appointments, and his boats were the most luxurious that were ever piloted on the famous water thoroughfare. There used to be ordinary bunks on the line, the crudest kind of berths. Shreve made up his mind that something better was demanded and the more luxurious that night travel was made the more traffic there would be on his lines. So he had a number of rooms built on his boat for night travelers.

Then the idea suggested itself to him that instead of numbering the rooms he would give each of them a name. This was done forthwith. He was a patriotic soul and he named the rooms after the great commonwealths through which the father of waters traveled. There, for instance, was the Mississippi room, the Alabama room, the Louisiana room, the Missouri room and so on down the list of states. In booking these names for passengers he called them "staterooms," hence the now universal expression.

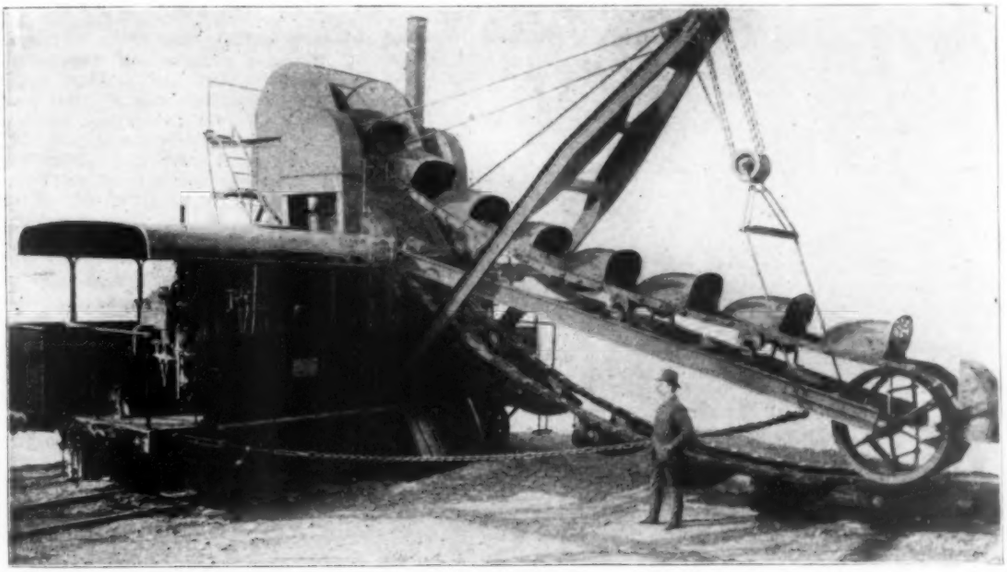
BRANDING SCENE ON THE MONTANA RANGES.

In order to recognize the cattle belonging to each man or company feeding cattle on the great ranges of Montana it is necessary to brand a mark upon the flank of each. This cut, which is loaned by the Lewistown Argus, shows the operation.


Cowboys Branding Cattle

Europe's Endless Chain Excavators

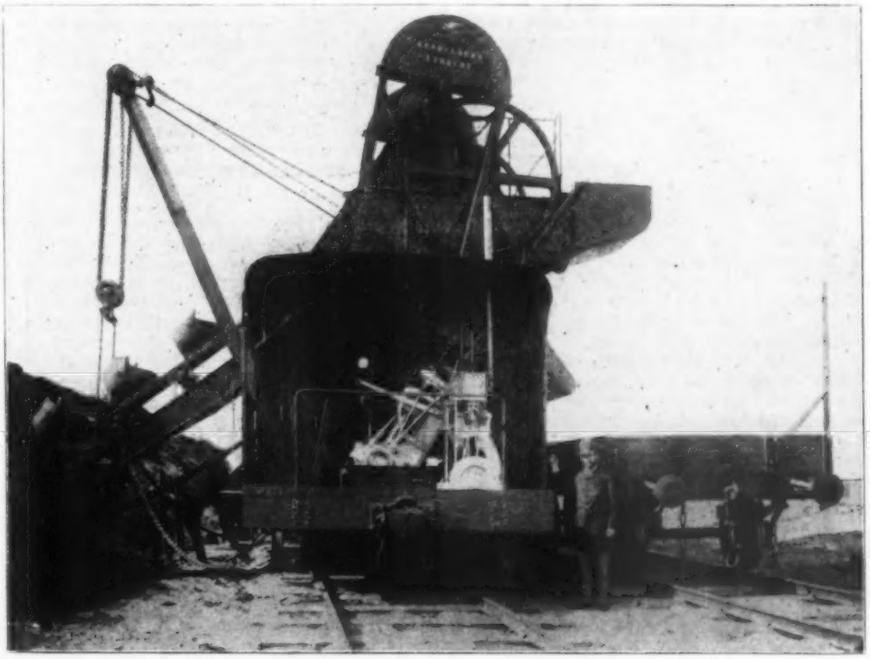
Not as Convenient as the American Steam Shovel, but They Have Big Capacities



Smulder's Endless Chain Canal Excavator

In Germany and other European countries excavating is done by an endless chain machine, this being considered superior to our method of digging with the steam shovel or dipper excavators. The American steam shovel is lighter and can handle larger rocks and other rough material and larger cars may be used in carrying the excavated material away. The European endless chains, however, are said to have a greater capacity and can accomplish much more in a day's work.

The Railway Review in discussing the relative merits of the two styles of excavators, says: The endless chain machines are heavier and usually require larger track facilities, while these in which the cars pass through a tunnel in the machine must utilize smaller cars, although large ones may be employed where the material passes over the machine to the cars. It is claimed for the large foreign endless chain machines that they may be operated from the track on the bank and water in the excavation offers no obstruction to the working of the machine.



English Excavator at Work on the Panama Canal

Ozone to Purify Chicago Water

German Method to be Tried in the Western Metropolis With Hopes of Success

The process of sterilizing water by impregnating it with ozone, as is done in Wiesbaden and Paderborn, Germany, is to be tried in Chicago. The process consists in subjecting air to powerful electric currents, which "burn" the oxygen, thus producing ozone. The water is then impregnated with ozonified air, with the results that all the harmful germs in it are destroyed.

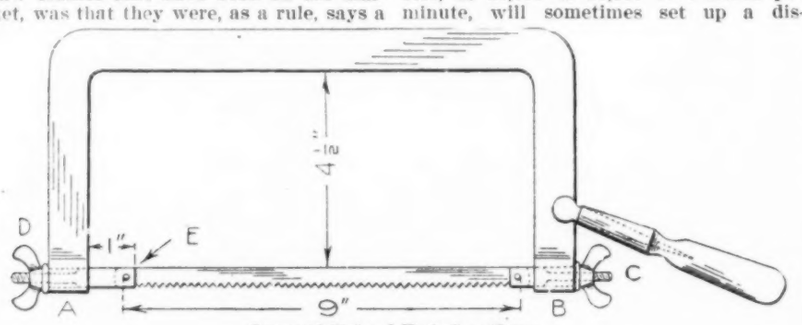
Hugo Jone, chemist and analyist at the Chicago municipal laboratories, says: "The system has passed its experimental stage. The germs of typhoid fever, Asiatic cholera, and dysentery are killed by ozone without fail. This is not always the case in filtration through sand or even through charcoal. By the introduction of ozone the problem of sterilizing, purifying and revivifying water easily and completely without danger of making the water harmful has been solved."

City Engineer Ericson says: "There is no question of the efficiency of the ozone process in the purification of water. Heretofore, however, although its effects have been recognized by all, its expense has been great, practically prohibitive, except with small quantities of water. There is an immense amount of water to be treated in Chicago, 400,000,000 million gallons a day, and the process must be rapid. If the German chemists have secured a process of ozonizing water that is both inexpensive and quick, they have solved the problem of a pure water supply in large cities."

SHOP NOTES

HOW TO MAKE A HACK SAW FRAME.

The trouble I have had with the hack saw frames that have been on the market, was that they were, as a rule, says a writer in American Blacksmith, too light, and the handle was so small and ill shaped that it cramped the hand, and as it became painful one lost control of the saw and made a mistroke which resulted in a broken saw. Therefore I took a piece of tire steel, 1x3-16 inches, bent it into shape as shown in the cut, scarfed and turned the end, B, over a piece of round 5-16-inch steel and welded the scarf, which for all practical purposes only requires sticking. The end, A, was turned over a square piece in the same way, and the hole trued up with a square file. The round hole was squared only at its front ends so that when the thumb nut, C, was turned only two turns, the square part of the saw holder could be turned in other directions. The saw holder at the other end of the saw was left longer, so the end of it would strike the piece being sawed and not the thumb where it usually strikes at E. The handle was a chisel handle, 1½ inches at its largest part, the shank being welded to the frame as shown and bent down until the natural center of the hand was in line with the saw blade. Otherwise the frame could be made in the manner hack saws usually are. If made of spring steel the frame might be made lighter, but I find the extra weight an advantage rather than a fault, and I find the frame being made 4½ inches from the saw a still greater advantage. The handle may seem out of shape when the saw is turned to the side, but it is not more so than those now in use, and its much greater convenience when used where nearly all the sawing is done is too great for it to signify.



Improved Style of Hack Saw Frame

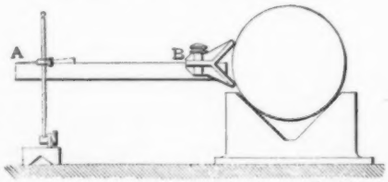
NOISY GEAR WHEELS.

The difference between noisy gears and quiet gears is often so slight that an expert cannot decide, by mere inspection, to which class a given paid of gears belongs. Both kinds are not infrequently produced in the same lot, apparently under the same conditions. This is disquieting, and may lead to misunderstandings. The inspector has heard so many explanations as to how the bad work came about that he has become skeptical, and when he is told that the noisy gears were turned, cut and fitted to place exactly like the quiet gears, his belief in narrative statements receives another shock.

A pair of gears about an inch in diameter, at 10,000 to 15,000 revolutions per minute, will sometimes set up a distressing noise, approaching the shriek of a small steam whistle, which may come from motion of the air and not from faults of constructions. And so a constructor of gears has a peculiar anxiety—he is not at all concerned as to the geometrical movements of his gearing so long as it will keep quiet. He has various devices, other than the correct shaping of the teeth, with which he hopes to avoid disagreeable sounds; if he has light power to transmit, he may choose a fine pitch for the teeth; he may make his gears of brass, sometimes of rawhide, and again of compressed paper.

FINDING THE CENTER OF A SHAFT.

The sketch shows a simple method of finding the center, or rather the height of the center, of a large shaft without turning it half way around, as is usually done, says a writer in the American Machinist. Apply the combination square to the side of the shaft, as shown, and bring both ends of the blade, A and B, to the same height by the surface gauge and this will be the height of the center. This method can be used when the shaft is over the lathe centers if a parallel piece or other level support is provided for the surface gauge. I have found it convenient to have a scratch on the tailstock spindle and also on the front of the headstock just the height of the center.



FINDING THE CENTER OF A SHAFT.

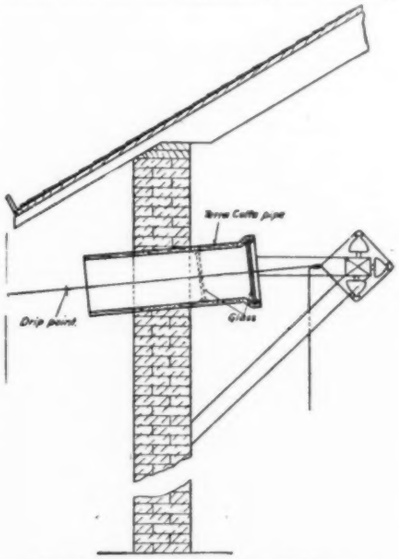
TO REMOVE THE RUST.

Rust on steel may be removed thus: Cover the steel with sweet oil, rub it in well and let it stand for 48 hours. Then rub the steel with unslaked lime finely powdered, till all the marks have disappeared.

HANDLING OF HIGH-TENSION CONDUCTORS.

The method of bringing high-tension conductors into buildings, according to The Electrical Review, depends upon the voltage of the transmission circuit, the climate in which the plant is operated, the size of the high-tension conductor, the kind and height of building used, and the conditions of approach to the building and the location of the apparatus in the building to which the high-tension line is connected. The requirements to be met are the maintenance of proper insulation of the circuit, the prevention of the entrance of rain, snow, cold air and dust, the proper mechanical fastening of the line wire, and the reliability and simplicity of construction.

In general, wires are best brought through the walls of the building. The simplest form of construction consists merely of an opening in the wall sufficiently large to allow the proper air insulation between the wire and the wall, this opening being suitably protected from rain either by means of a large pipe set in the wall, sloping outward, or by a sufficient extension of the roof above, or both. The requirements of this form of construction are that the wire be a sufficient distance from the pipe, so that there will be no possibility of striking across under any conditions. The pipe should always be considered as "ground," regardless of the construction of the building.



Showing Method of Handling Conductor

The insulating tube should slope outward and a drip point should be provided on the wire just outside the end of the tube. The insulation slab holding the tube should be large enough to prevent actual breakdown even though the tube is broken. Both tube and slab should be fireproof material. This form of construction has been successfully used for potentials as high as 50,000 to 60,000 volts. The tower construction might be necessary where the building is low but the same problem is presented as in going through the wall. Boring the wires through the roof is possible but requires great precautions. No combustible material should be used near the live wire even when separated by insulating material.

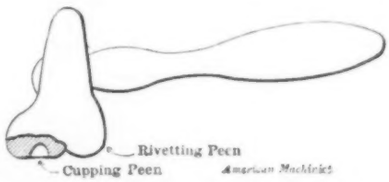
HOW TO MAKE A CHEAP STUFFING BOX.

It frequently happens that it is necessary to rig up a force pump temporarily, or sometimes permanently, upon the farm, in the country grist mill or saw mill, or in the molasses factory, says the American Thresherman. Very often a common pump cylinder with piping and rods is at hand. But where it is desirable to force the water above the point of delivery a stuffing box of some sort is necessary. These are not generally carried in stock by most hardware stores and are usually more or less expensive. But a stuffing box which will answer any ordinary purpose can easily be constructed with no other materials than a pipe coupling, a pipe plug of corresponding size and two washers of such a diameter that they will slip easily inside of the coupling, but will not go inside of the pipe itself. The hole in the center of the washers should be of such a size as to permit their free passage over the pump rod, but no larger. A hole must be drilled through the pipe plug of the same diameter as the holes in the washers and it must be exactly in the center, or as near the center as possible. If there is any difference in the lengths of the pipe couplings at hand it is better to secure one of good length, as the stuffing box will then contain a larger amount of packing. This reduces the liability of leakage. After the coupling has been screwed to the end of the pipe, first the two washers and then the plug should be slipped over the pump rod. The packing is inserted between the two washers and adjusted by screwing down the plug with a wrench. It is not absolutely necessary to use the upper washer at all. Pipe plugs are usually made with the threaded part tapered in order to more successfully fulfill the purpose for which they were originally intended. It is evident that this is an objectionable feature when they are to be used for stuffing box glands, as the packing can be tightened but little before the plug will become tightly screwed into the coupling. This undesirable state of affairs can largely be overcome by taking a socket wrench and screwing the pipe plug nearly or quite through a pipe die of the same size. This will make the plug of the same diameter throughout its length, and on account of fitting more loosely in the coupling give a wider range of adjustment to the packing. It is not necessary that the stuffing box should be of the same pipe size as the delivery pipe. For instance, if the delivery is 1½ inches, the stuffing box can be reduced to 1 inch and will answer the purpose just the same, although it is not advisable to make it too small. One inch is a good size for pump rods of the usual diameter. A pipe bushing or even a nipple can be used for a gland in the place of a plug, although in this case the use of the upper washer cannot be dispensed with; but the plug is preferable if properly drilled, because it acts as a sort of guide to the rod in case of any side strain, and thus lengthens the life of the packing.

Do you want to know how to earn a full set of castings for building a one-horsepower gasoline engine? If so, write to Popular Mechanics.

A RIVETING AND CUPPING HAMMER.

An English contributor to the American Machinist writes: "In passing through a sheet metal workers' shop I observed a workman riveting hinges on kettle lids very smartly by the aid of a light hammer, as shown in the cut. After passing the lid and hinge over the rivet, previously placed head down on a cupped anvil, a few blows with the slightly rounded peen, followed by a rather heavier blow with the cupped peen, produced a neat cup head finish."



A RIVETING AND CUPPING HAMMER.

This particular trade is extremely sensitive as to the publicaion of trade secrets, and the tool will doubtless be new to many of our readers.

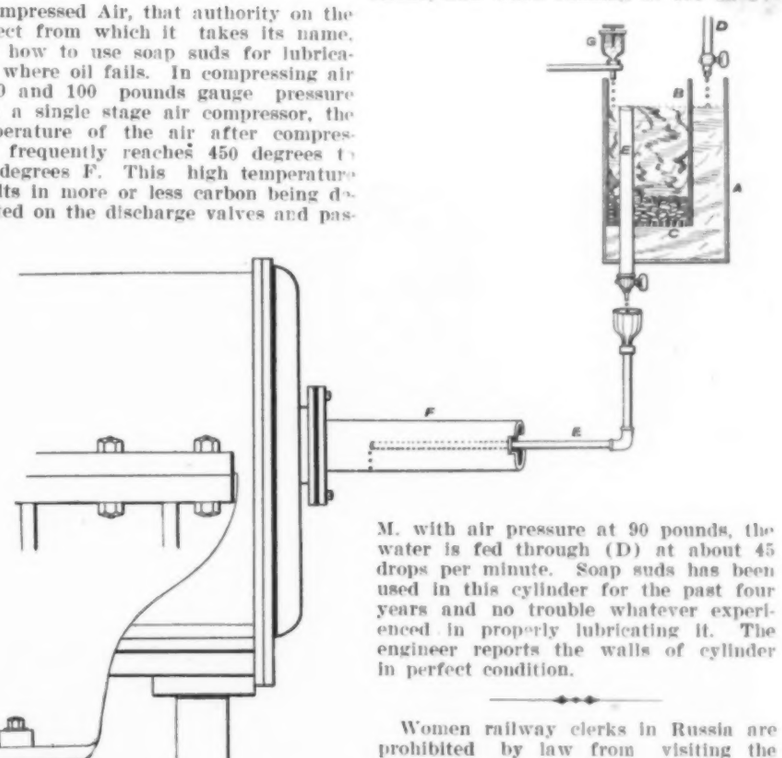
LUBRICATOR FOR FEEDING SOAP SUDS TO COMPRESSORS.

Compressed Air, that authority on the subject from which it takes its name, tells how to use soap suds for lubrication where oil fails. In compressing air to 90 and 100 pounds gauge pressure with a single stage air compressor, the temperature of the air after compression frequently reaches 450 degrees to 500 degrees F. This high temperature results in more or less carbon being deposited on the discharge valves and passages, and trouble is often experienced in properly lubricating the air cylinder.

Especially is this the case where compressors are run at high speed and the temperature of intake air exceeds 80 degrees, or where an inferior grade of oil is used. To overcome this trouble, soap suds has frequently been used as a lubricant instead of oil, with good results.

The illustration shown herewith shows a novel way of feeding soap suds into a cylinder provided with piston inlet valve, and will, no doubt, be of interest to engineers who are using machines of this kind, who have experienced the trouble referred to above. The device consists of a small galvanized iron water tank (A) about 7 inches long, 6 inches wide and 12 inches deep. Inside of this tank is a smaller one (B), which is soldered to the large tank, and the bottom of which is about 2 inches above the bottom of the large tank. In the bottom of the small tank are a number of holes ⅛-inch in diameter, shown at (C). Soft brown soap (cut up in small pieces) is put into tank (B). Water is then fed into large tank through a ¼-inch pipe (D) and passes through small holes at (C), dissolves some of the soap and raises to top of ¼-inch pipe (E), through which it passes down into inlet of compressor. The water is regulated at (D), the small cock under tank being left wide open. Just before shutting down compressor the water is turned off at (D) and oil is fed into the small tank (B) from cup (G). The compressor is then run with oil for half an hour to prevent rust. It is important to use soap that will sink in water, otherwise small chips of soap will float to top of tank (B) and pass down through pipe (E).

This device is used on an Ingersoll-Sergeant compressor having a steam cylinder 14 inches in diameter by 18-inch stroke, and when running at 150 R. P. M. with air pressure at 90 pounds, the water is fed through (D) at about 45 drops per minute. Soap suds has been used in this cylinder for the past four years and no trouble whatever experienced in properly lubricating it. The engineer reports the walls of cylinder in perfect condition.



Women railway clerks in Russia are prohibited by law from visiting the offices of male superiors.

The engineers of the army are displacing the old searchlights of the various seacoast batteries with lights of almost double power.

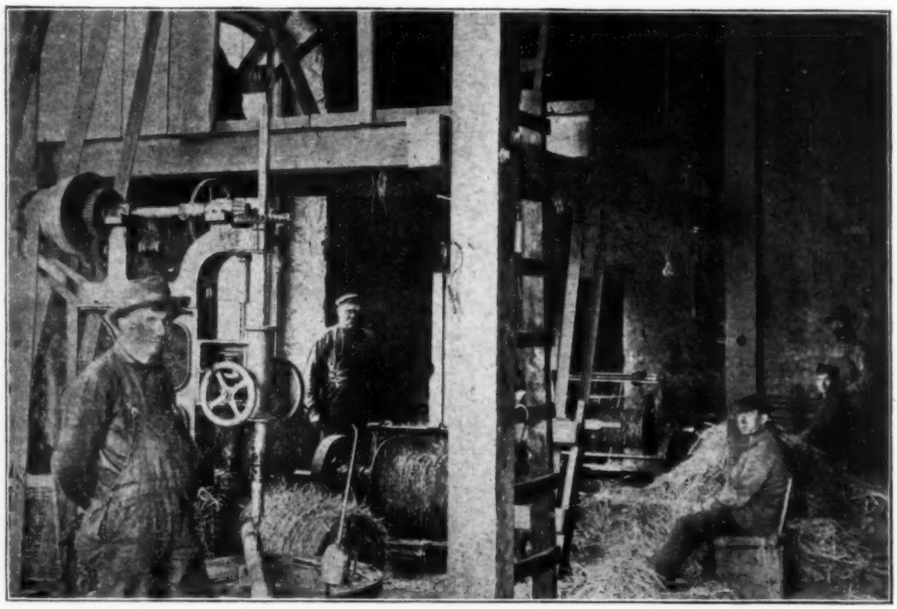
The total single-track railway mileage in the United States at the close of the last fiscal year, June 30, was 202,471 miles, an increase during the year of 5,234 miles.

Through a Modern Pipe Foundry--Part II

Core Making--Ingenious Methods of Spinning Rope From Straw or Marsh Hay

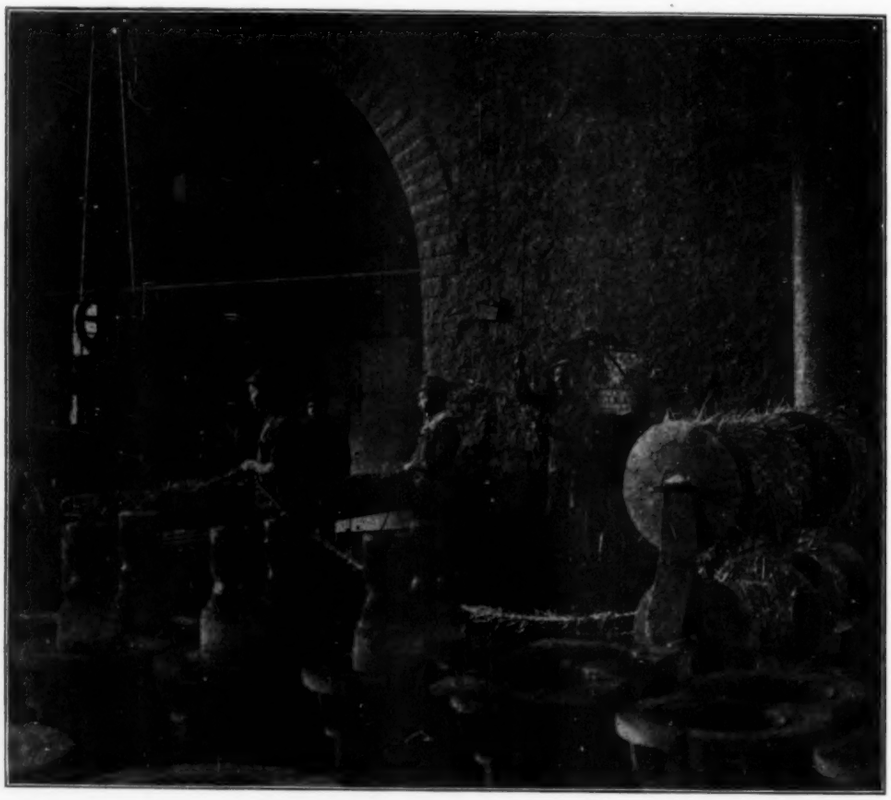
By W. N. Crocker, Superintendent of the Min qua Works of the Colorado Fuel & Iron Co., and Contributor to Camp and Plant

While the molds are being rammed up as described in Popular Mechanics last week, a gang is busy making up the cores, starting with a steel or cast pipe, well drilled for ventilating as a core bar. These bars are turned by power or hand, and a rope, spun from straw or marsh hay, by the ingenius machines shown in one of the accompanying illustrations, is closely wound from end to end of the bar. "Haying" a four-inch core bar is shown in the illustration on the opposite page. The lower illustration on this page shows the process of core making. A visitor seeing the great amount of rope being used for each pipe thinks he ought to take an hour off to show the benighted foundryman some method to avoid this expense, not appreciating that nearly everyone connected with the industry has ben laboring for years to do away with the use of rope. While many core compounds have been tried, and numberless collapsing bars designed to allow the bars to be withdrawn after casting, none, it seems, so perfectly meets the conditions of work here that the use of hay has been permanently done away with in any shop in the United States.



Rope Room

This shows the two rope making machines in which hay is twisted into rope which varies into diameter from one-half inch to one inch, according to the size of core wanted. The drill-press shown in the foreground at the left is used in making repairs for the foundry.



Core Making

Round hollow bars are wrapped with straw rope, then coated with a mixture of adobe and ordinary sand. They are then dried and given a second coating of adobe and blacking. They are again dried in an oven over night for use the next day.

The hay on the bar is held in place by a strong first coat of clay on which, when dried, a second coat is struck, a core board being used to bring the core to its proper size. This board also tapers the cores at the bottom, so that they will center in the casting plate when placed in the mold.

In making cores for three- and four-inch pipe loose hay is used to wrap the core bars instead of hay rope.

When the hot iron is poured into the mold the hay or hay rope ignites, although separated from the iron by the clay on the outside of the hay. When the hay or rope is burned the bar slips out easily leaving inside the pipe the coat of clay originally smeared on the outside of the core. After blacking the cores are placed in the core ovens and dried.

In small pipe the inside of the socket is often struck upon the body core, although a socket core made separately, to slip over a straight body core, is preferred by many, as constant depth of socket is thus assured. For large pipe the sockets are made up separately on an

iron socket ring which fits in the casting, the body core centering in this ring.

The eighteenth annual report of the Department of Inspection of Workshops, Factories and Public Buildings of the State of Ohio is an extremely able one, containing over 600 pages. J. H. Morgan is chief inspector.

Build a one-horsepower engine this summer. Write to Popular Mechanics for particulars.

"Haying" a Four-Inch Core Bar

In making cores for three and four-inch pipe loose hay instead of hay rope is used to wrap the core bars. This shows the north end of the foundry and the edge of the smaller of the two pits where pipes of from three to six inches in diameter are cast.

Dyke 1903

No. 8 Auto Supply Catalogue

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RAILROADS KILLED 8,588 LAST YEAR.

More than Were Injured on all the Steamboat Lines in the World

To those who believe it is more dangerous to travel on water than land, the report of the Interstate Commerce Commission for the past fiscal year will afford some enlightenment. The total number of casualties to persons due to railway accidents in the United States was 73,250, or more than on the combined steamship lines of the world. Of this appalling list 8,588 persons were killed and 64,662 injured. The deaths on United States railroads exceeded the list of injured on all the steamship lines in existence. Of railway employes alone in the United States 2,969 were killed and 50,524 injured. One out of every 401 employes was killed and one out of every 24 employes was injured.

TO IMPROVE NEGATIVES AND LANTERN SLIDES.

A combined intensification and reduction is recommended by Prof. H. Kessler for the improvement of lantern slides, or even negatives which are foggy or flat, says the Photo-Beacon. The negative or lantern slide, when dry, is bleached completely with bichlorid of mercury, washed for about a quarter of an hour, and then blackened with a solution formed of sodium sulphite 50 grams, metol 5 grams, water 550 ccm., until the blackening has penetrated through to the glass side. Then wash again and reduce with the ordinary Howard Farmer reducing bath, composed of hyposulphide of soda and ferricyanid of potassium, until the picture has become clear. Finally wash thoroughly. The above blackening solution is given in place of the usual sodium sulphite or ammonia, as otherwise the intensification would entirely disappear in the reducer.

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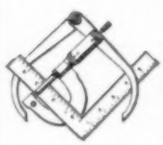

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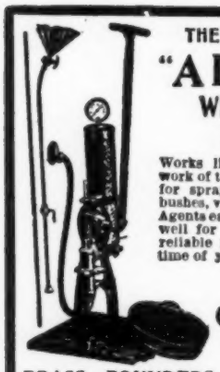

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Man's a fool!
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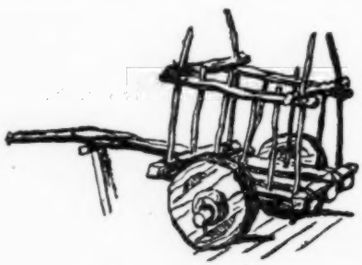
He wants it cool.
When it's cool
He wants it hot.
Ne'er content with
What he's got,
Always wanting
What is not
I maintain that
As a rule,
Man's a fool.

A CEMENT FOR MARBLE.

Anyone having occasion to mend a broken switchboard panel, or otherwise join two pieces of marble, will be interested to know of a cement suitable for the purpose, says Steam Engineering. According to a German exchange, the cement should be prepared and used as follows: Mix intimately four parts of gypsum and one part of finely powdered gum arabic; then with a cold solution of borax make into a mortar-like mass. Smear on each face of the parts to be joined, and fasten the bits of marble together. In the course of a few days the cement becomes very hard and holds very tightly. To get the best results the object mended with the cement should be left entirely quiet for several days, not touching or moving it. In mending colored marbles the cement may be given the hue of the marble by adding the color to the borax solution.

OX CART 200 YEARS OLD.

An old ox-cart used in Louisiana more than 200 years ago, is shown in the illustration. It is to form part of the transportation exhibit at the St. Louis world's fair.



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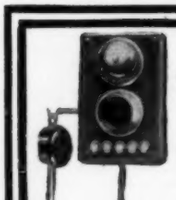

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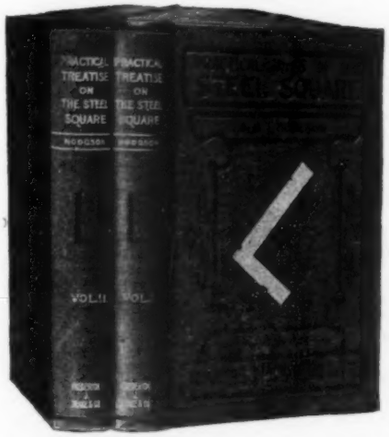

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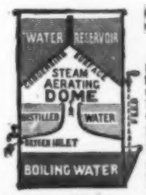

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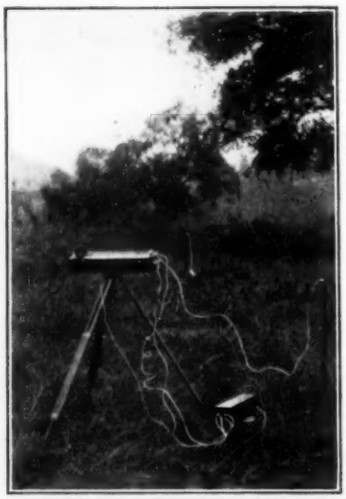

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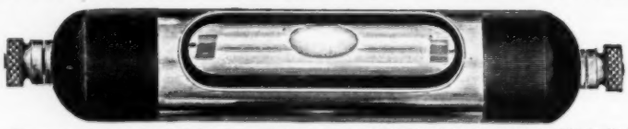

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